Banisteria, Number 6, 1995

Observations on *Sorex longirostris* (Mammalia: Soricidae) and Associates in Eastern Portions of the Historical Great Dismal Swamp

Sandra Y. Erdle[1] and John F. Pagels[2]
Department of Biology
Virginia Commonwealth University
Richmond, Virginia 23284-2012

Museum specimens and associated data stored in natural history museums have become increasingly important resources. Such specimens can have great biological, economic and political value. In portions of southeastern Virginia, biological surveys and resultant specimens have assumed much importance as metropolitan areas expand and land use is altered. One of the animals that has been the focus of interest in this area is the southeastern shrew, *Sorex longirostris* Bachman. Of three subspecies currently recognized, the nominate form, *S. l. longirostris*, is distributed throughout much of the southeastern portion of the United States, *S. l. eonis* is restricted to portions of Florida, and *S. l. fisheri* is found in and nearby the Great Dismal Swamp of Virginia and North Carolina.

In 1986, the U.S. Fish and Wildlife Service listed the Dismal Swamp southeastern shrew, *S. l. fisheri*, as threatened. Primary reasons for its listing were the shrew's very limited range and the potential for genetic swamping, or a loss of the taxon, because of increased contact between *S. l. fisheri* and *S. l. longirostris*. In particular, outside the Great Dismal Swamp National Wildlife Refuge (GDSNWR) loss of swamp habitat has occurred primarily because of ditching, draining and clearing for agriculture, urban development, and other land uses. Such activity may provide inroads of suitable habitat for *S. l. longirostris* into existing *S. l. fisheri* habitat. Rose et al. (1987) reported specimens of intermediate size along the perimeter of the GDSNWR. Rose & Padgett (1991) summarized various aspects of the biology of *S. l. fisheri*, including threats to its existence.

Ongoing studies of *S. longirostris* in southeastern Virginia that have included expanded field surveys, additional morphometric analyses and molecular analyses (personal communications, N. D. Moncrief, Virginia Museum of Natural History; R. K. Rose, Old Dominion University; W. D. Webster, University of North Carolina at Wilmington) are nearing completion. These studies should provide a wealth of information on the distribution of *S. longirostris* in southeastern Virginia and northeastern North Carolina, and resolve current systematic problems. Information reported herein further delineates ranges of *S. l. fisheri* and *S. l. longirostris* in eastern portions of the historical Great Dismal Swamp. It also emphasizes importance of biological surveys and how sampling for a target species can provide baseline data on other forms, or may lead to additional questions of biological significance.

Materials and Methods

Twenty-four sites were sampled in the Cities of Chesapeake and Virginia Beach (Fig. 1) from June 1990

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[1] present address: Virginia Department of Conservation and Recreation, Division of Natural Heritage, 1500 East Main Street - Suite 312, Richmond, Virginia 23219

[2] to whom correspondence should be addressed

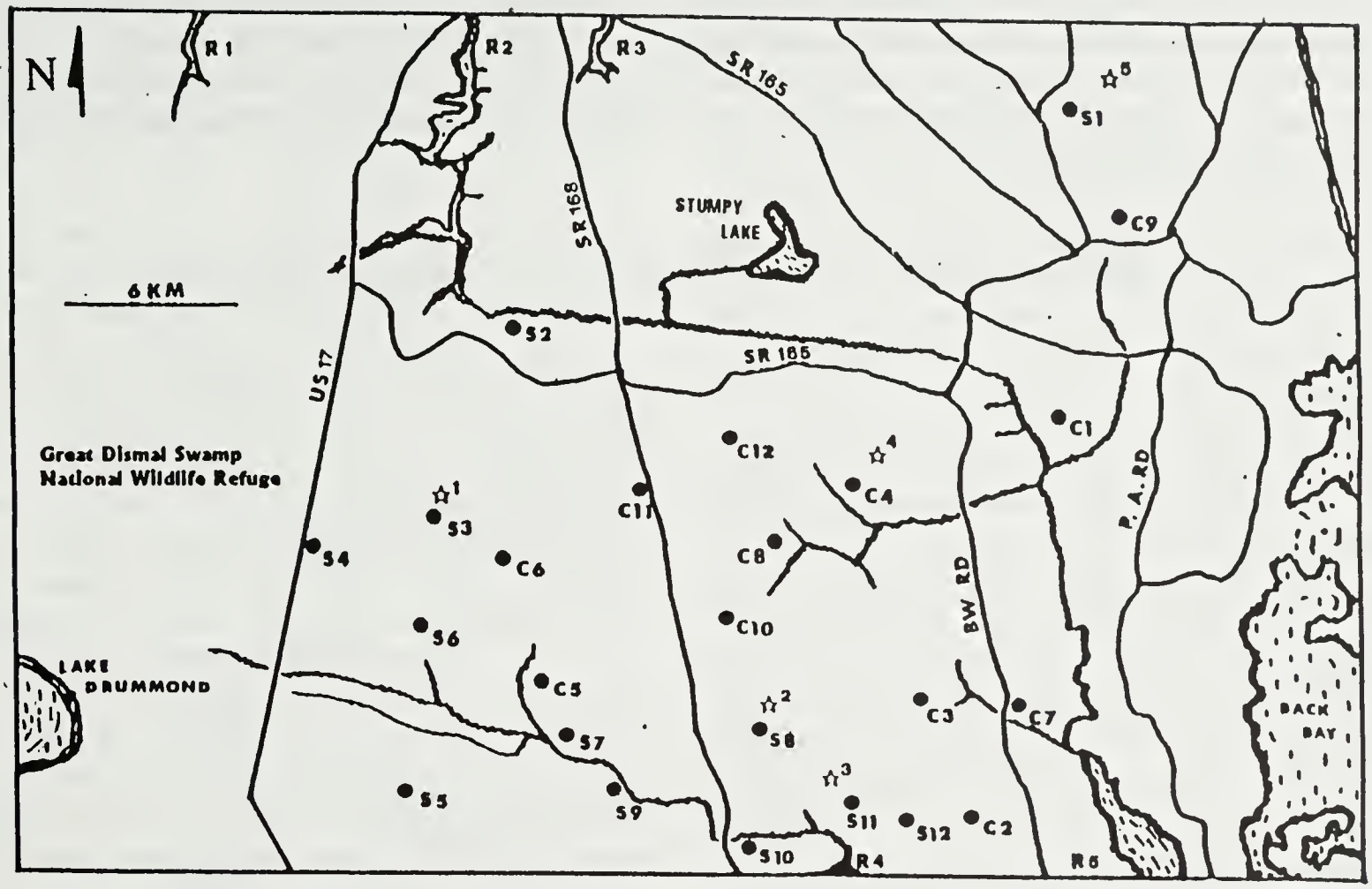

Figure 1. Map of portions of the cities of Chesapeake and Virginia Beach, Virginia, with collection sites indicated by dots. Trap sites at the sites S1 to S12 and C1 to C12 are noted in Table 1 and described in the text. Stars with numerals indicate landmarks: 1 is Chesapeake Municipal Airport, 2 is St. Brides Correctional Center, 3 is Northwest River Park, 4 is Fentress Naval Air Station, and 5 is Oceana Naval Air Station. Rivers are indicated by the letter "R" and numerals: R1, R2, and R3 are portions of the Western Branch, Southern Branch, and Eastern Branch of the Elizabeth River, respectively, and R4 and R5 are the Northwest River and the North Landing River, respectively.

to November 1991. Habitats sampled ranged from grassy fields to forests of various ages and types (Table 1). Because of the patchiness of habitat types in the study area, a range of habitat types was sampled at many sites. Pitfall traps were used in all sampling sites, either with a drift fence and 3.8-l (#10 tin cans) pitfalls (fence on Table 2) at each end, or with smaller 0.47-l (16 oz aluminum cans) pitfalls (can on Table 2) without drift fences, or both. Plastic 7.6-l (two gallon buckets) pitfalls were also used at site S3. Traps were half filled with a dilute formalin solution to facilitate drowning and for preservation of specimens. Traps were checked approximately bi-monthly. Standard external measurements were taken from fluid preserved specimens. Skulls of all *Sorex longirostris* were removed and cleaned. Specimens were deposited in the Virginia Commonwealth University Mammal Collection. Additionally, visual comparisons were made of shrews captured in this study with specimens of *S. l. fisheri*, including topotypes, at the U.S. National Museum of Natural History (USNM).

Results and Discussion

A total of 254 mammals was captured representing 12 species (Table 2). The method of sampling, primarily 3.8-l and smaller cans, yielded a high proportion of shrews, 78% of all captures. This result was not unexpected (see Mitchell et al., 1993).

Table 1. General habitat type for each of the sites sampled. Abbreviations: hardwood forest (hw), grassy field (gr), mixed hardwood and pine (mi), pine forest (pw), sappling (sapl), shrub (shr), sites with drift fences (S), sites without drift fences (C). Hw/mi indicates forests that were primarily hardwood but contained scattered pines. "X" indicates a habitat type within a site. A dashed line indicates the range of habitats within a site. An asterisk in parentheses indicates sites of capture of *Sorex longirostris* spp.

Site	Old field			Edge	Forest	
	gr	gr/shr	shr/sapl	Shrub/forest	young	mature
S1						hw(*)
S2		X[a]				
S3	X(*)-----	X-----		X-----	X-----	Pine (*)
S4					-----	hw(*)-----
S5		X(*)[b]				
S6					-----	mixed(*)-----
S7						hw(*)
S8				X(*)		hw
S9				X(*)		
S10				X		mixed(*)
S11						hw/mi
S12						hw/mi[c]
C1						pine(*)
C2				X(*)		
C3				X		
C4				-----	shrub-----	
C5						X(*)[d]
C6					-----	pine-----
C7				X(*)		
C8		X		X		
C9				X(*)		
C10			X			
C11			X			
C12		X	X	X(*)	-----	shrub-----

[a] Edge of marsh

[b] 5-20m from mature swamp forest

[c] Swamp edge

[d] Much cypress

All five species of shrews known from the Coastal Plain of Virginia, southeastern shrew, *Sorex longirostris* (Sll and Slf, see Table 1), pygmy shrew, *S. hoyi* (Sh), least shrew, *Cryptotis parva* (Cp), short-tailed shrew, *Blarina brevicauda* (Bb), and the southern short-tailed shrew, *B. carolinensis* (Bc), were taken in the relatively small area sampled.

Sorex hoyi was known from only seven sites in Virginia in 1980 (Handley et al., 1980), and although now known from many more sites and a broad range of elevations, it was still considered one of Virginia's rarest shrews less than 10 years ago (Pagels, 1987). The pygmy shrew was first reported from the vicinity of the Great Dismal Swamp in Camden and Gates counties in North Carolina (Padgett & Rose, 1994). As a result of recent efforts to study Virginia's shrews and the use of highly-effective pitfall traps, *S. hoyi* is now known to have the greatest distribution (elevation, longitude and latitude) of any Virginia shrew.

Four species of shrews were captured at site S7, among them *Blarina brevicauda* and *B. carolinensis*, species that are contiguously allopatric in most of the central to eastern portions of North America where their ranges meet. Their presence together in the present study is one of the few situations where they are known to be sympatric (Tate et al., 1980; Pagels & French, 1987).

Sorex longirostris was captured at 16 of 26 sites. The 54 specimens of this species comprised 22% of total mammal captures, similar to the 20.6% for *S. longirostris* reported by Rose et al. (1987) in a study that used 3.8-l cans as pitfall traps set in a grid. Pagels et al. (1992) used 19-l buckets in a study of small mammals in Cumberland County, Virginia, and though rodents represented a much higher percentage of mammals captured in those large traps, *S. longirostris* still represented more than 11% (86 of 754) of mammals captured in this Piedmont study. Specimens from the Piedmont study and from this study more than tripled the number of *S. longirostris* known from Virginia as recently as 1982 (Pagels et al. 1982).

French (1980) reported that the isolated subspecies, *S. l. eionis* and *S. l. fisheri*, are approximately 20% greater in total body length than *S. l. longirostris*. Padgett et al. (1987), Rose et al. (1987), Jones et al. (1991), and Padgett (1991) provided additional observations on identification of *S. l. longirostris* and *S. l. fisheri* in southeastern Virginia. Although total length is of questionable systematic value, and can vary a great deal depending on specimen condition and measurement technique, it can be helpful in sorting specimens into different size groups. Total lengths of our specimens ranged from 77 mm to 90 mm. If shrews with a total length of 90 mm are designated as *S. l. fisheri* (see Rose et al., 1987; Padgett, 1991), those 85-88 mm as intermediates (intergrades), and those 84 mm and less, as *S. l. longirostris*, then specimens referrable to both taxa, *S. l. longirostris* and *S. l. fisheri*, are represented in our sample, as well as specimens that are intergrades. Skulls of our largest specimens compared favorably with topotype specimens of *S. l. fisheri* at the USNM, however we made no comparative measurements.

The largest specimens, i.e., those referrable to *S. l. fisheri*, were caught nearest (S4, S5, C6) the Dismal Swamp (Table 2, Figure 1). The smallest specimens, i.e., those referrable to *S. l. longirostris*, were caught throughout the study area. That small specimens were captured in the same area as the largest specimens would seem to be important in assessing the distributional dynamics of the two taxa.

Sorex longirostris was captured in most habitats sampled. Our findings relating to habitat were similar to existing information on *S. l. longirostris* in much of Virginia (for example, Pagels et al., 1982; Pagels & Handley, 1989), and data from studies in and near the Great Dismal Swamp (for example, Rose, 1981; Rose et al., 1987; Rose et al., 1990). Rose & Padgett (1991) summarized that "...*S. l. fisheri* persists within the mature forests of the Dismal Swamp at relatively low densities, but quickly invades and increases in numbers in early to mid-successional habitats created by clearing....". Unfortunately, such habitats that have been altered by draining are also desirable for *S. l. longirostris*, which may lead to genetic extinction of *S. l. fisheri* if its range is indeed restricted to the vicinity of the Great Dismal Swamp.

All other captures were rodents; harvest mouse, *Reithrodontomys humulis* (Rh), white-footed mouse, *Peromyscus leucopus* (Pl), marsh rice rat, *Oryzomys palustris* (Op), hispid cotton rat, *Sigmodon hispidus* (Shi), meadow vole, *Microtus pennsylvanicus* (Mpe), pine vole, *Microtus pinetorum* (Mpi), and house mouse, *Mus musculus* (Mm). Interestingly, rodents were represented by only a small percentage (22%) of total mammal captures.

Table 2. Numbers of captures of small mammals in 24 study sites in the cities of Chesapeake and Virginia Beach, Virginia. Trap types are described in the text and site localities are plotted on Figure 1. Abbreviations for each species captured are in the text.

Site	trap	Sll	SlF	Sh	Cp	Bb	Bc	Rh	Pl	Op	Shi	Mpe	Mpi	Mm	Tot
S1	fence	2	0	0	0	0	16	4	3	0	0	2	0	0	27
	can	1	0	0	0	0	6	0	0	0	0	0	0	0	7
S2	fence	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	can	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S3	fence	0	0	0	3	1	0	1	0	0	0	1	0	0	6
	can	0	0	0	5	0	0	0	0	0	0	0	0	0	5
	bucket	3	0	0	7	0	3	6	0	0	0	0	0	1	20
S4	fence	3	1	1	0	7	0	0	2	0	0	0	0	0	14
S5	fence	4	2	0	3	0	0	1	2	0	0	0	0	0	12
	can	6	0	0	1	4	0	0	0	0	0	0	0	0	11
S6	fence	0	0	0	0	3	0	1	2	0	0	0	0	0	6
	can	2	0	0	1	1	0	0	0	0	0	0	0	0	4
S7	fence	4	0	0	2	1	4	1	3	0	0	0	0	0	15
S8	fence	0	0	0	1	0	6	1	1	0	0	1	1	0	11
	can	5	0	0	0	0	8	0	0	0	0	0	0	0	13
S9	fence	3	0	0	1	0	2	1	0	1	0	0	1	0	9
S10	fence	3	0	0	0	1	5	1	0	0	0	1	0	0	11
	can	0	0	0	0	0	5	0	0	0	0	0	0	0	5
S11	fence	0	0	0	2	0	3	1	0	0	0	0	0	0	6
	can	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S12	fence	0	0	0	0	0	1	0	2	0	0	0	0	0	3
	can	0	0	0	0	0	2	0	0	0	0	0	0	0	2
C1	can	4	0	0	0	0	4	1	0	0	0	0	0	0	9
C2	can	2	0	0	0	0	4	0	0	0	0	0	0	0	6
C3	can	0	0	0	0	0	4	0	1	0	0	0	0	0	5
C4	can	0	0	0	0	0	4	2	0	0	0	0	0	0	6
C5	can	3	0	0	0	0	0	0	0	0	0	0	0	0	3
C6	can	1	1	0	0	0	0	0	0	0	0	0	0	0	2
C7	can	2	0	0	1	0	1	1	0	0	0	0	1	0	6
C8	can	0	0	0	0	0	2	1	1	0	0	1	1	0	6
C9	can	1	0	0	0	0	3	0	0	0	0	0	0	0	4
C10	can	0	0	0	0	0	6	0	2	0	0	0	0	0	8
C11	can	0	0	0	0	1	2	0	0	0	1	0	1	0	5
C12	can	1	0	0	0	0	5	0	0	0	0	0	0	0	6
Total		50	4	1	27	22	93	23	20	1	1	6	5	1	254

These results are again indicative of the efficacy of small pitfall traps when sampling for shrews, and the need for multiple capture techniques when attempting to assess entire small mammal populations (Mitchell et al., 1993).

In summary, pitfall sampling in this study that used a relatively simple spot-trapping technique provided data that may be useful in evaluating the status of a threatened species and its small mammal associates.

Acknowledgements

We thank the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) for initiation of this project. Funding was provided by the U.S. Fish and Wildlife Service (USFWS) and The Nature Conservancy. J. Jacobs formerly of the USFWS, C. A. Pague, formerly of DCR-DNH, and K. Terwilliger, formerly of the Virginia Department of Game and Inland Fisheries, were key individuals in many aspects of the study. We thank J. E. Pagels, K. L. Uthus, and K. A. Buhlmann for help in the field, and R. D. Fisher for allowing us access to specimens at the USNM. We are grateful to personnel at the Chesapeake Municipal Airport, the Northwest River Park, and to numerous private landowners for allowing us to sample on their property. W. D. Webster and J. C. Mitchell provided helpful comments on the manuscript.

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Banisteria, Number 6, 1995

A New Station for Smooth Cliffbrake, *Pellaea glabella*, (Pteridaceae) on Masonry Walls

Thomas F. Wieboldt
Massey Herbarium, Department of Biology
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

During June 1995, I was shown a luxuriant population of cliffbrakes (*Pellaea*) growing in mortar on the walls of Owens Hall on the campus of Virginia Polytechnic Institute and State University in Montgomery County, Virginia. Numerous plants of both *Pellaea atropurpurea* and *glabella* grow together here in an area previously deeply shaded and hidden from view by shrubbery. Although both *Pellaea* species occur predominantly on natural outcroppings of limestone or dolomite, *P.atropurpurea* occurs on a wider variety of rock types and has been recorded a number of times on old stone or brick walls (Massey, 1944). *Pellaea glabella*, on the other hand, is much more restricted both geographically and in habitat preference.

Although at the southeastern edge of its range and once thought to be quite uncommon in Virginia, *P. glabella* is characteristic of limestone or dolomite palisades that occur along major rivers and large creeks. It is now known from many counties in the Great Valley in Virginia. There are few occurrences of this fern on man-made structures. A search through past issues of the American Fern Journal yielded only two accounts of masonry structures as habitat for *P. glabella*. Interestingly, one such report provides a photograph of another site in Montgomery County where this fern occurs on "wing-walls of a railroad culvert" over Plum Creek (Knight, 1939; Massey, 1944). This station is only a few hundred meters from a natural outcrop where the species also occurs. By contrast, the VPI & SU station is at the very least 8.8 kilometers distant. This, of course, poses no problem as the tiny spores are easily airborne and transported long distances. Knight's note in the American Fern Journal is followed 4 years later by a note by Edgar T. Wherry (1943) reporting stations in